Journal: HESS
Title: Revisiting the Hydrological Basis of the Budyko Framework with the Hydrologically Similar Groups Principle
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Response to Reviewer#1:

General Comments:

The authors used global data sets to analyze an impressive number of catchments in order to calculate their position on the Budyko curve. They use the results to establish correlation between the single parameter of a parametric expression of the Budyko curve and various catchment characteristics. In the discussion, the results are analyzed to provide physical explanations for some of these correlations.

Overall, the paper is sound and the analysis provides new insights, making this an interesting paper that I enjoyed reading.

Response:

Thank you for your positive comments. Your suggestions are very useful for us to improve our research. We revised our manuscript according to your comments. The changes in our manuscript are underlined with red. We believe our manuscript improved a lot after the modification. Please see the response below.

Comment 1:

I would like the Introduction to clarify better the role of the parameter.

Response:

Thanks for the good suggestion. We added more description of the role of the parameter as follows,

"From the hydrological point of view, the Pw controls the fraction of precipitation diverted into the runoff for a given aridity index (Caracciolo et al., 2018). Watersheds with larger Pw values converts larger parts of precipitation to evapotranspiration and consequently less part to runoff than those with smaller Pw value; and some studies defined the Pw as the water retention capacities of watersheds (Fu, 1981; Zhou et al., 2015). Overall, the Pw denotes the adjustment of water-energy partitioning by watershed characteristics (Yao et al., 2017; Li et al., 2013)."

Comment 2:

The results indicate there is a temporal trend in the quality of the runoff reconstruction. I would like to see some examples of this for individual catchments, and if possible some more discussion of this.

Response:

Thank you. We have added Supplement 3 in the revised manuscript to show the simulation results of average annual runoff and validation results of time series runoff reconstruction for each GRDC watershed. At the same time, we have added the analysis of individual typical watersheds, as follows,

"The reconstructed time-series runoffs in the Milk River watershed (GRDC station number: 4220501) and Near Lethbridge watershed (GRDC station number: 4213111) both show an underestimation of annual runoff in the arid areas. The Milk River and the Near Lethbridge are two adjacent watersheds with similar drainage areas located on the border of the United States and Canada. However, the underestimation is more serious in the Milk River watershed (RelBIAS=-0.32, annual mean P/PET=0.52) than in the Near Lethbridge watershed (RelBIAS=-0.27, annual mean P/PET=0.55)."

Comment 3:

The readability of the figures is poor because too much information is jammed in many panels comprising a single figure. Trying to read Fig. 7, I had to enlarge it so such a degree that the resolution became too coarse.

At times, the English is a bit hard to comprehend.

Response:

Thank you for pointing out this. In the revised manuscript, for the Fig. 7 of the original manuscript, we have separated the line plot into Fig. 8 and the scatter plot into Fig. 9 to make them easier to understand. In addition, we have modified the English expressions to make them easier to read.

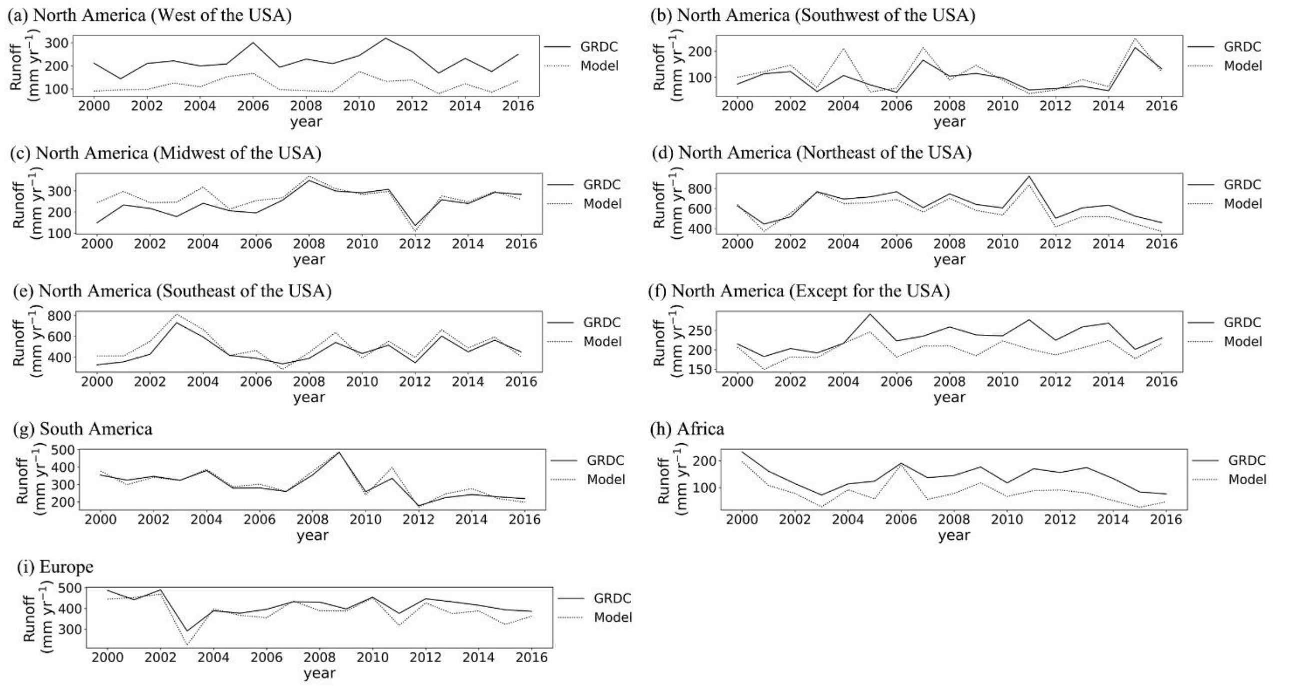

Figure 8. Observed time-series runoffs versus reconstructed time-series runoffs. Nine geographic sub-regions were in Fig. 1: North America ((a) west, (b) southwest, (c) midwest, (d) northeast, (e) southeast, (f) except of the USA), (g) South America, (h) Africa, and (i) Europe.

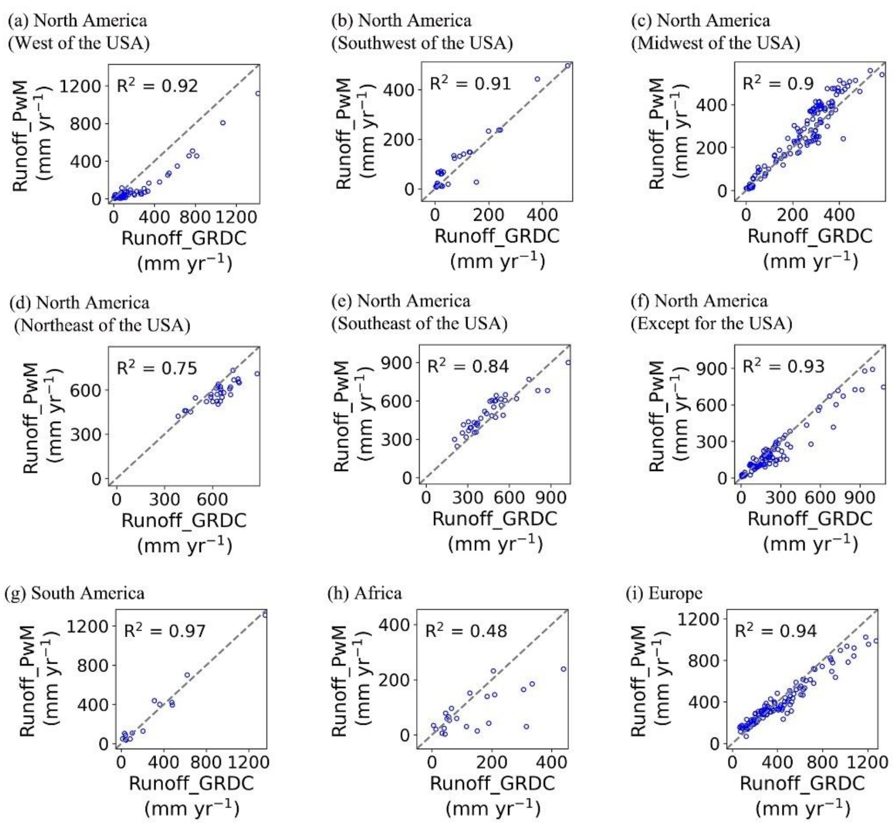

Figure 9. Scatterplots between observed annual mean runoffs and reconstructed annual mean runoffs. Nine geographic sub-regions were

in Fig. 1: North America ((a) west, (b) southwest, (c) midwest, (d) northeast, (e) southeast, (f) except of the USA), (g) South America, (h) Africa, and (i) Europe.

Comment 4:

Carefully check the notation and explanation of all variables and make them consistent throughout. Two examples: PET and ET0 both denote the potential evapotranspiration, and Pw and m denote the watershed characteristic parameter.

Response:

Thank you. As your suggestion, we have checked and revised the notation and explanation of all variables to make them consistent. In our revised manuscript, the abbreviation of the watershed characteristic parameter was unified as the Pw, the actual evaporation was unified as the ET, the runoff was unified as the R, the precipitation was unified as the P, and the potential evapotranspiration was unified as the PET.

Comment 5:

Figs. 5 and 6 present quantitative data in poorly readable color scales. But placing these in tables is not manageable because of the large number of catchments. Still, information for individual catchments would be useful. Perhaps add such a table as a supplement? Perhaps you can expand the table for annual data, so we can see the trend that you report in the aggregate in the main text for individual catchments.

Response:

Thank you for your suggestion. In the revised manuscript, we have revised the color of Fig.6 (i.e., Fig.5 in the original manuscript) and Fig.7 (i.e., Fig.6 in the original manuscript), and added Supplement 3 to show the simulation results of average annual runoff and validation results of time series runoff reconstruction for each GRDC watershed.

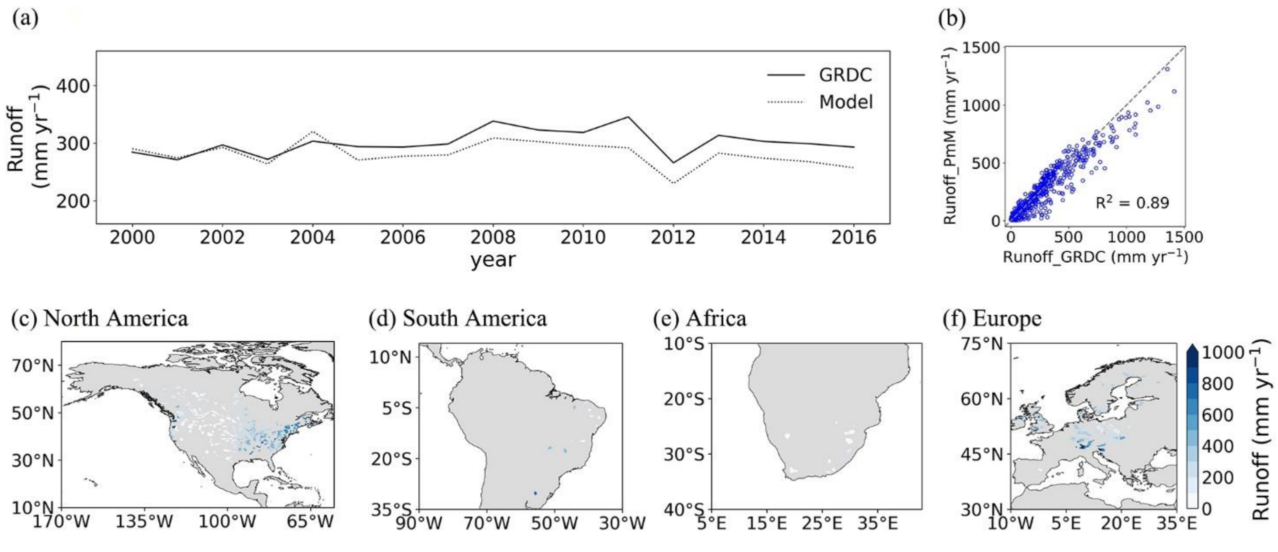

Figure 6. Time-series runoff reconstruction results in the selected GRDC stations. (a) Time-series annual mean runoff of the selected 545 GRDC watersheds; (b) Scatterplot between the modeled runoff and observed runoff; The spatial distribution of annual mean runoff in (c) North America, (d) South America, (e) Africa, and (f) Europe.

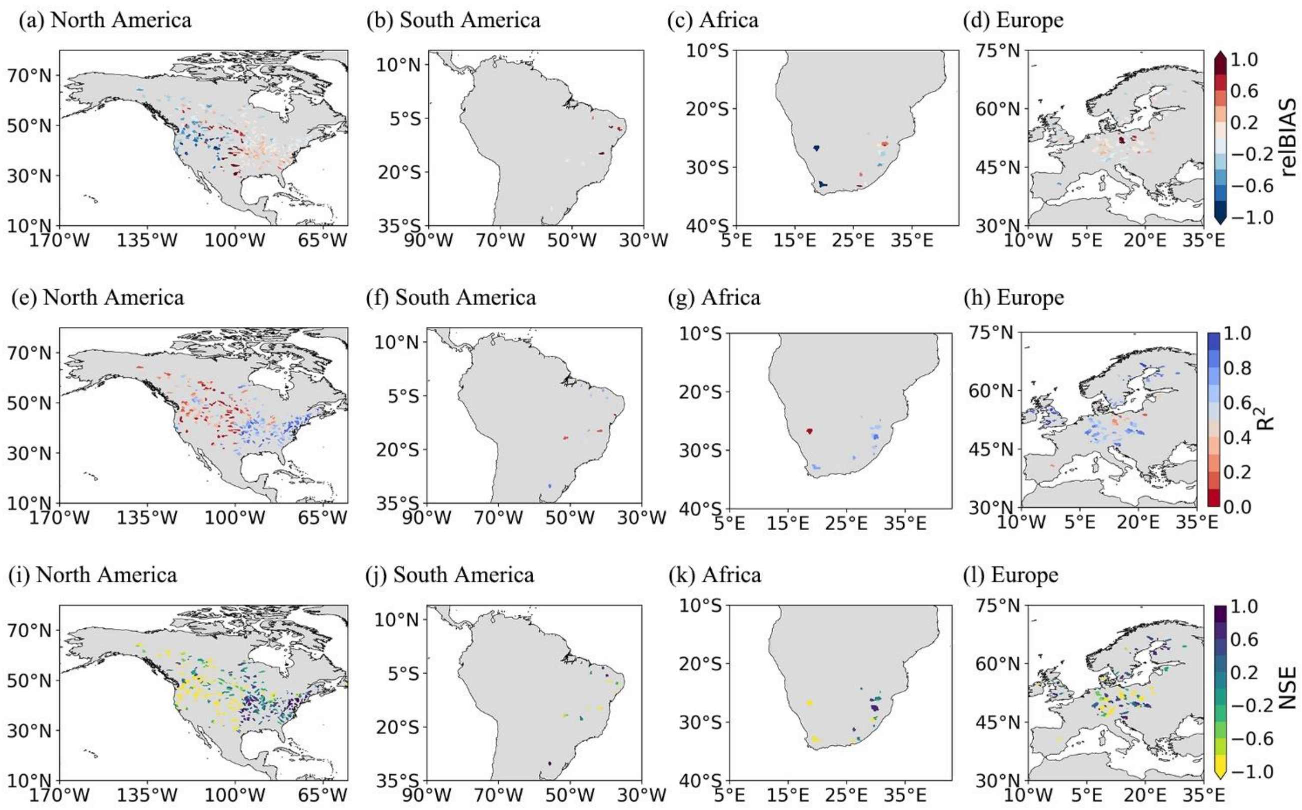

Figure 7. Spatial distribution of the skill scores of the reconstructed time-series runoffs.

Additional minor comments:

Comment 6:

Line18 "global watersheds"

They are watersheds all over the globe (more or less). The term global watershed suggests that the watersheds covers the entire globe.

Later in the text you also use global to mean 'at various locations on the globe'. Perhaps rephrase these for more clarity.

Response:

Thanks for your consideration. In our study, we collected 726 records of hydrological data in 366 watersheds from globally published datasets for modeling, and used 17 years of runoff data in selected 545 GRDC stations for validation. To avoid confusion, we modified the relevant expression as follows,

"We firstly classified the selected 366 watersheds worldwide into six hydrologically similar groups based on watershed attributes, including climate, soil moisture, and vegetation."

"Overall, 726 records of hydrological data in 366 watersheds from globally published datasets were collected for analyses (Supplement 1). These 366 watersheds were classified into six hydrologically similar groups according to the hydrologically homogenous attributes of watersheds using the Decision Tree Regressor method."

"For the selected 545 GRDC watersheds, the annual runoff estimated by the PwM ranges from 229.84 to 320.34 mm, which is slightly lower than the observed range of GRDC (265.82 ~ 345.50 mm yr^{-1}) (Fig. 6a)."

Comment 7:

Line32 "Introduction"

The rationale of the work and its objectives are clearly presented here, but it would greatly help if you add a paragraph explaining the properties and meaning of parameter Pw.

Response:

Good idea. As your suggestion, we have added the properties and meaning of the Pw in the introduction, as follows,

"As a result, hydrologists have invested considerable efforts to improve model performance by introducing parameters related to watershed characteristics (watershed characteristic parameter, Pw) into the original Budyko equation. The popular parametric equations of the Budyko framework are presented in Table 1."

"From the hydrological point of view, the Pw controls the fraction of precipitation diverted into the runoff for a given aridity index (Caracciolo et al., 2018). Watersheds with larger Pw values converts larger parts of precipitation to evapotranspiration and consequently less part to runoff than those with smaller Pw value; and some studies defined the Pw as the water retention capacities of watersheds (Fu, 1981; Zhou et al., 2015). Overall, the Pw denotes the adjustment of water-energy partitioning by watershed characteristics (Yao et al., 2017; Li et al., 2013)."

Comment 8:

Line51-53 "Some of the introduced parametric equations include the Fu (Fu, 1981), Zhang (Zhang et al., 2001), Choudhury-Yang (Yang et al., 2008), and Wang-Tang equations (Wang and Tang, 2014)."

There are many more equations. Is there a particular reason for focusing on this subset?

Response:

Thanks for your question. The Fu (Fu, 1981), Zhang (Zhang et al., 2001), Choudhury-Yang (Choudhury, 1999), and Wang-Tang (Wang and Tang, 2014) equations are the popular Budyko-type parametric equations. They have been proven the good performance in previous studies (Guan et al., 2022; Caracciolo et al., 2018). Among the parametric equations, Fu's equation has received the most application and turned out to be a more generalized form (Zhou et al., 2015). So, we focused on this subset and used Fu's equation to analyze the Pw in the Budyko framework.

Comment 9:

Line54 "Table 1." To make this table intelligible on its own, please provide units or dimensions for all variables, as well as their range, if and when appropriate.

Response:

Good idea. As your suggestion, we have added the units of variables, and the theoretical range and reference values of Pw in the table1, as follows,

Table 1. Parametric Budyko-type formulations (Pw - watershed characteristic parameter; ET - actual evaporation, R - runoff, P - precipitation, PET - potential evapotranspiration, all in mm yr^{-1}).

Reference	Formulation	Pw (Theoretical range)	Reference values of Pw
Budyko (1974)	$\frac{ET}{P}=\left[\frac{PET}{P}\tanh\left(\frac{PET}{P}\right)^{-1}(1-exp(-\frac{PET}{P}))\right]^{0.5}$	0.5	0.5
Zhang et al. (2001)	$\frac{ET}{P}=\frac{1+w\frac{PET}{P}}{1+w\frac{PET}{P}+(\frac{PET}{P})^{-1}}$	w (0, ∞)	Trees – 2.0, Plants – 0.5
Turc (1954), Mezentsev (1955), Choudhury (1999), Yang et al. (2008)	$\frac{ET}{P}=\frac{1}{\left[1+(\frac{P}{PET})^{n}\right]^{\frac{1}{n}}}$	n (0, ∞)	Field – 2.6, River basins – 1.8

Wang and Tang (2014)	$\frac{ET}{P}=\frac{1+\frac{PET}{P}-\sqrt{(1+\frac{PET}{P})^2-4\varepsilon(2-\varepsilon)\frac{PET}{P}}}{2\varepsilon(2-\varepsilon)}$	ε (0,1)	0.55 - 0.58
Tixeront (1964), Fu (1981), Zhou et al. (2015)	$\frac{R}{P}=\left[1+\left(\frac{P}{PET}\right)^{-m}\right]^{\frac{1}{m}}-(\frac{P}{PET})^{-1}$	m $(1,\infty)$	Forest – 2.83, Shrub – 2.33, Grassland or cropland – 2.28, Mixed land – 2.12

(Lines 47-49 in the revised manuscript)

Comment 10:

"Table 1." "Fu (1981)" This parenthesis must go.

Response:

Sorry for neglecting. We have carefully reviewed the relevant formulas and revised them.

Comment 11:

Line56-57 "taking into account the influence of watershed characteristics"

Please explain how.

Response:

Thank you. The parametric Budyko-type formulations introduced the parameters related to watershed characteristics (Pw, i.e., *w* in Zhang equations, *n* in Yang equations, and *m* in Fu equations) to control the fraction of precipitation diverted into the runoff for a given aridity index(Caracciolo et al., 2018), and denote the adjustment of water-energy partitioning by watershed characteristics (Yao et al., 2017; Li et al., 2013). To explain this more clearly, we have rewritten this section, as follows,

"From the hydrological point of view, the Pw controls the fraction of precipitation diverted into the runoff for a given aridity index (Caracciolo et al., 2018). Watersheds with larger Pw values converts larger parts of precipitation to evapotranspiration and consequently less part to runoff than those with smaller Pw value; and some studies defined the Pw as the water retention capacities of watersheds (Fu, 1981; Zhou et al., 2015). Overall, the Pw denotes the adjustment of water-energy partitioning by watershed characteristics (Yao et al., 2017; Li et al., 2013).

During the past decades, researchers have done lots of work to quantify the Pw for the accurate simulation of evapotranspiration or runoff using the Budyko framework (Wang et al., 2022; Yao et al., 2017; Guo et al., 2019; Yu et al., 2021) and made considerable contributions for improving the estimation of Pw by taking into account the influences from watershed characteristics (Fu, 1981; Liu and Liang, 2015; Guan et al., 2022; Yang et al., 2008)."

Comment 12:

Line59-60 "watershed characteristic parameter (Pw)"

This parameter does not appear in any of the equations of Table 1. Please introduce it a bit better, clarify its role, and how it connects to the equations you introduced before.

Response:

Thank you. The watershed characteristic parameter is *w* in the Zhang equations, *n* in the Yang equations, ε in the Wang and Tang equations, and *m* in the Fu equations. In the revised manuscript, we have listed the Pw symbol of the parametric Budyko-type formulations to show how the Pw relates to the equations in Table.1. Subsequently, we have added the descriptions of the role of Pw in the introduction. The modifications are as follows,

"As a result, hydrologists have invested considerable efforts to improve model performance by introducing parameters related to watershed characteristics (watershed characteristic parameter, Pw) into the original Budyko equation. The popular parametric equations of the Budyko framework are presented in Table 1.

Table 1. Parametric Budyko-type formulations (Pw - watershed characteristic parameter; ET - actual evaporation, R - runoff, P - precipitation, PET - potential evapotranspiration, all in mm yr^{-1}).

Reference	Formulation	Pw (Theoretical range)	Reference values of Pw
Budyko (1974)	$\frac{ET}{P} = \left[\frac{PET}{P}\tanh\left(\frac{PET}{P}\right)^{-1}(1 - exp(-\frac{PET}{P}))\right]^{0.5}$	0.5	0.5
Zhang et al. (2001)	$\frac{ET}{P} = \frac{1 + w\frac{PET}{P}}{1 + w\frac{PET}{P} + (\frac{PET}{P})^{-1}}$	w (0, ∞)	Trees – 2.0, Plants – 0.5
Turc (1954), Mezentsev (1955), Choudhury (1999), Yang et al. (2008)	$\frac{ET}{P} = \frac{1}{\left[1 + (\frac{P}{PET})^{n}\right]^{\frac{1}{n}}}$	n (0, ∞)	Field – 2.6, River basins – 1.8
Wang and Tang (2014)	$\frac{ET}{P} = \frac{1 + \frac{PET}{P} - \sqrt{(1 + \frac{PET}{P})^2 - 4\varepsilon(2 - \varepsilon)\frac{PET}{P}}}{2\varepsilon(2 - \varepsilon)}$	ε (0,1)	0.55 - 0.58
Tixeront (1964), Fu (1981), Zhou et al. (2015)	$\frac{R}{P} = \left[1 + \left(\frac{P}{PET}\right)^{-m}\right]^{\frac{1}{m}} - (\frac{P}{PET})^{-1}$	m (1, ∞)	Forest – 2.83, Shrub – 2.33, Grassland or cropland – 2.28, Mixed land – 2.12

From the hydrological point of view, the Pw controls the fraction of precipitation diverted into the runoff for a given aridity index (Caracciolo et al., 2018). Watersheds with larger Pw values converts larger parts of precipitation to evapotranspiration and consequently less part to runoff than those with smaller Pw value; and some studies defined the Pw as the water retention capacities of watersheds (Fu, 1981; Zhou et al., 2015). Overall, the Pw denotes the adjustment of water-energy partitioning by watershed characteristics (Yao et al., 2017; Li et al., 2013)."

Comment 13:

Line71-73 "Although many studies have researched the relationship between the Pw and various watershed characteristics factors, they have shown contradictory results."

This appears to contradict line 60-61. Apparently, it is not a terribly convincing parameter according to some. In the next paragraph it becomes clear where you are going with your line of thinking, so perhaps it is OK to leave the text as it is.

Response:

Thanks for your consideration. Previous studies have proved that the parametric Budyko-type formulations have better performance than non-parametric equations by assigning empirical value to Pw (Guan et al., 2022). However, the further study found that Pw values varied greatly in different watersheds and deviate from the previously given empirical value (Zhang et al., 2018). During the past decades, researchers have done lots of work to quantify the Pw for the accurate simulation of evapotranspiration or runoff using the Budyko framework (Wang et al., 2022; Yao et al., 2017; Guo et al., 2019; Yu et al., 2021) and made considerable contributions for improving the estimation of Pw by taking into account the influences from watershed characteristics (Fu, 1981; Liu and Liang, 2015; Guan et al., 2022; Yang et al., 2008). Although previous studies still differed greatly as to what factors and effects should relate to the Pw and failed to give a general framework for quantifying the Pw, the Pw is undeniably a very important parameter for the Budyko Framework. Therefore, more in-depth studies are in need for revisiting the hydrological Basis of Pw in the Budyko Framework. In the revised manuscript, we rewrote this section to describe that in detail.

"During the past decades, researchers have done lots of work to quantify the Pw for the accurate simulation of evapotranspiration or runoff using the Budyko framework (Wang et al., 2022; Yao et al., 2017; Guo et al., 2019; Yu et al., 2021) and made considerable contributions for improving the estimation of Pw by taking into account the influences from watershed characteristics (Fu, 1981; Liu and Liang, 2015; Guan et al., 2022; Yang et al., 2008). Although there is agreement that the Pw represents the integrated effects of various environmental factors (Wang et al., 2022; Liu et al., 2022; Yu et al., 2021; Gan et al., 2021), studies still differed greatly as to what factors and effects should relate to the Pw and failed to give a general framework for quantifying the Pw. For instance, whether the Pw in the Budyko framework is controlled by vegetation or not has been much debated. Ning et al. (2017) found that the Pw generally had a positive correlation with vegetation coverage. Zhang et al. (2018) obtained the sensitivity of the Pw to changes in LAI by taking a derivative of the Pw function with respect to LAI, implying a crucial role of vegetation cover in impacting the Pw. However, some other studies indicated that most regions or watersheds show no significant influences of vegetation indices or coverage on Pw (Li et al., 2013; Liu et al., 2021). For example, Li et al. (2013) pointed out the variations in the Pw values are not entirely controlled by vegetation coverage in the small catchments. Another study from Liu et al. (2021) also found a weak correlation between the vegetation leaf area index and the Pw. Therefore, more in-depth studies are in need for revisiting the hydrological Basis of Pw in the Budyko Framework."

Comment 14:
Line96 "PET"
Was that not labeled ET_sub_zero above? If yes, make the notation consistent throughout.
Response:

Thanks for your consideration. As your suggestion, the abbreviated symbol for potential evapotranspiration was unified as PET in our revised manuscript.

Comment 15:
Line118 "the new Fu's formula"
To me it appears to be exactly the same as Fu's equation in Table 1 if m is set equal to w.
So, what is new about it? Because you did not explain the meaning of Pw above we cannot tell.
Response:

Sorry for neglecting. The "new Fu's formula" in the original manuscript is the variation form of Fu's formula. We have changed "the new Fu's formula" to "the Fu's formula" in the revised manuscript.

Comment 16:
Line123 "m is a dimensionless integration constant"
There is no integration carried out. Also, integration constants by definition cannot have a limited range of validity.
Response:

Thank you, according to your comments, we have changed the "a dimensionless integration constant" to "a dimensionless constant".

Comment 17:
Line124-125 "Based on the randomly selected 726 samples from global hydrological studies, we derived the Pw (m) values for each sample."
How? Did you fit Eq. (1) to catchments with R, P, and PET observed?

Response:

Thanks for your question. First, we calculated the R/P and P/PET for each site by using collected and extracted the R, P, and PET data. Then, we derived the Pw values according to Equation 1.

Equation 1: $\frac{R}{P} = \left(1 + \left(\frac{P}{PET}\right)^{-Pw}\right)^{\frac{1}{Pw}} - \left(\frac{P}{PET}\right)^{-1}$

where R/P is a dimensionless annual water yield coefficient; P/PET is an aridity index; and Pw is a dimensionless constant varying from 1 to infinity, and represents water retention capacity for evapotranspiration.

Comment 18:

Line129 "variable"

'any suitable watershed characterisitic variable'

Response:

Thanks. we have changed "the relationship between Pw and a variable does not change substantially in a hydrologically similar group" to "the relationship between Pw and the watershed characteristic variable does not change substantially in a hydrologically similar group" in the revised manuscript.

Comment 19:

Line132 "soil moisture (SM)"

How do you define this? For me it is a volume fraction occupied by liquid water, but in Table 3 it is larger than 1.

Response:

Thanks. The soil moisture (SM) in our study is the water that is in the upper 10 cm of soil extracted from GLDAS Noah Land Surface Model L4 and its unit is kg m^{-2}. To be consistent with the units of runoff depth, we changed the units of SM to "mm" representing the depth of water in the 10cm soil layer. In the revised manuscript, we have made the following modifications to the relevant parts,

"The watershed characteristic factors selected in this study include surface soil moisture (0-10cm underground, SM), fractional vegetation cover (FVC) and seasonal index (SI) of Walsh and Lawler (1981)."

Table 2. Data sources for watershed characteristic factors

Watershed characteristic factors	Data source/version	Units	Reference
Surface soil moisture (0-10cm underground, SM)	GLDAS Noah Land Surface Model L4	mm	Rodell et al. (2004)
Fractional vegetation cover (FVC)	GLASS FVC V4	m^2 m^{-2}	Liang et al. (2021)
Seasonal index (SI)	CRU TS dataset version 4.03, global maps of seasonality indices	dimensionless	Walsh and Lawler (1981);Feng (2019)

Comment 20:

Line148 "x_i represents the input variables"

Only the ith one, it is not a vector, otherwise the summation makes no sense.

Is there a reason why you made the model additive, and not multiplkicative, for instance?

Response:

(1) The symbol of the input variables

We have redefined the symbol of the input variable in Equation 2 as follows,

"We performed regression analysis between the Pw and watershed characteristic variables to determine the input variables of the PwM. The variables whose R^2 of the regression model was greater than 0.1 were selected as input variables. We used a polynomial as the basic model form. Each term of the polynomial depends on the regression model of the corresponding variable and the Pw. For each hydrological group, the PwM is modeled as a function as,

$$Pw = \sum Coef\_n \times f(Var\_n) \tag{2}$$

where *Pw* represents the value of the Pw; *VarN* represents the input variable that pass the regression test; *f* corresponds to the function derived from the regression of Pw on *Var_n*; *Coef_n* represents the empirical coefficient fitted by multiple non-linear regression (MNR)."

(2) Reasons for using addition

On the one hand, we want to set up the model with the simplest possible operations. The polynomial in addition is one of the simplest operations. On the other hand, error scales linearly with addition, and scales up to be proportional to your original data with multiplication. To avoid the extreme error that may be caused by the original data, we chose a more conservative addition as the basic operational framework.

Comment 21:

Line163

The outer brackets are not needed.

Response:

Thank you. We have done as suggested.

Comment 22:

Line192 "(10)"

Is this an emprical upper limit of m? It does not arise from the structure of the equation.

Line193-194 "extremely unlikely"

Well, you have around 700 catchments and many years of discharge data for each of them. There are bound to be a few very unlikely recharge events in your dataset.

Response:

Thank you for your question. Yes, 10 is an empirical value of Pw (i.e., m in Fu's equation). The Budyko approach was developed based on water balance concepts, so we need to assume that the watersheds in question are "conservative" (i.e., precipitation is the sum of streamflow and evapotranspiration). However, the natural watersheds with a large Pw value may be "non-conservative", because part of the water remain in the watershed may come from groundwater flow and other hardly or not measurable flows. To be more cautious, in this study, the empirical upper limit for Pw was 10 to ensure that the watersheds in question were conservative. In this regard, we have added the following contents in the revised manuscript,

"Pw is a dimensionless constant varying from 1 to infinity, and represents water retention capacity for evapotranspiration. When Pw=1, all the precipitation would become flow and the residence time is 0. When Pw→infinity, all precipitation would remain in the watershed and residence time would equal the time for all precipitation conversion to evapotranspiration. So, the natural watersheds with a large Pw value may be "non-conservative" (i.e., precipitation is not the sum of streamflow and evapotranspiration), because part of the water remains in the watershed may come from groundwater flow and other hardly or not measurable flows. To be more cautious, in this study, the empirical upper limit for Pw was 10 to ensure that the watersheds in question were conservative."

Comment 23:

Line221 "SM is soil moisture (kg m-2); FVC is fractional vegetation cover (m2 m-2)."

This information needs to be given on first occurrence, and for the other variables as well.

How deep is the soil layer for which SM is provided?

You use equivalent water layers (mm) for water throughout. Why not be consistent and report soil moisture

as mm as well? The numbers won't change.

Response:

Thanks. As your suggestion, the properties and units of the variables were given in the section of data. The soil moisture (SM) in our study is the water that is in the upper 10 cm of soil extracted from GLDAS Noah Land Surface Model L4 and its unit is kg m^{-2}. According to your suggestion, we changed the unit of SM to "mm" representing the depth of water in the 10cm soil layer to make it consistent with the units of runoff depth. The changes in the revised manuscript are as follows,

"Table 1. Parametric formulations of the Budyko framework (Pw - watershed characteristic parameter; ET - actual evaporation, R - runoff, P - precipitation, PET - potential evapotranspiration, all in mm yr-1)."

Table 2. Data sources for watershed characteristic factors

Watershed characteristic factors	Data source/version	Units	Reference
Surface soil moisture (0-10cm underground, SM)	GLDAS Noah Land Surface Model L4	mm	Rodell et al. (2004)
Fractional vegetation cover (FVC)	GLASS FVC V4	m^2 m^{-2}	Liang et al. (2021)
Seasonal index (SI)	CRU TS dataset version 4.03, global maps of seasonality indices	dimensionless	Walsh and Lawler (1981);Feng (2019)

Comment 24: Line242-243 "(c) Difference between the R/P values from the PmM and the published observations." The color scale is not very clear in the middle range.

Response:

Thank you. We changed the color of the figure as follows,

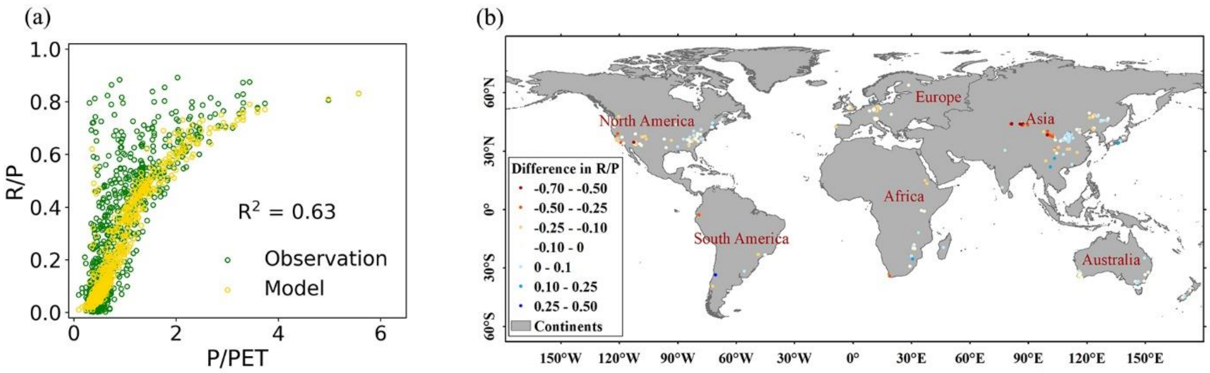

Figure 5. Simulated R/P using PwM in comparison with the observations collected from published literatures. (a) Scatter plots between R/P (yellow: simulation; green: observations) and P/PET; (b) Difference between simulated R/P from the PmM and observations from the published datasets.

Comment 25:

Line248-249 "the value of the lower adjacent larger than zero"

Unclear, please rephrase.

Response:

Thank you. We have modified this statement as follows,

"The grouped NSE scores show more uncertainty than the overall, especially in the IN_{WMS}: the lower adjacent value (LAV) larger than zero indicates more skill than the mean of observations, however, the outliers are far below zero."

Comment 26:

Line253 "at bootstrapped works"

Unclear, please rephrase.

Response:

Thank you. We have modified this statement as follows,

"**Figure 4.** Cross-validation results of PwM for (a) IN_D, (b) IN_{WP}, (c) IN_{WMS}, (d) IN_{WMM}, (e) IN_{WML}, and (f) IN_{WE}."

Comment 27:

Line256 "global annual runoff"

Do you really mean the estimated runoff from all the landmasses of the Earth? Because your use of 'global' is sometimes ambiguous I am not sure here.

Response:

Thanks for your consideration. The global annual runoff here refers to the annual runoff estimated from the selected 545 GRDC watersheds. In the revised manuscript, we modified it as,

"For the selected 545 GRDC watersheds, the annual runoff estimated by the PwM ranges from 229.84 to 320.34 mm, which is slightly lower than the observed range of GRDC (265.82 ~ 345.50 mm yr^{-1}) (Fig. 6a)."

Comment 28:

Line282 "on a global scale"

You do the opposite: you refine the scale from global to continental.

Line283-288 "The temporal evolution of runoff is, in general, well captured, except in the western United States, where runoff was consistently underestimated. In addition, the runoff estimated by PwM is underestimated in 2011 to a greater extent than in other years. The regions where runoff was underestimated include the western United States and high latitudes in North America, and the runoff underestimation is more severe in the arid western United States than in the relatively wet northwest of North America."

You do the opposite: you refine the scale from global to continental.

Response:

Thanks for your consideration. To avoid confusion, we have rewritten this section, as follows,

"Figure 7 displays the skill scores of the reconstructed runoff by the PwM in comparison with the GRDC ensemble from 2000-2016. It can be seen that the result of reconstruction by PwM, in general, is satisfactory, as indicated by the RelBIAS close to 0. The underestimation of runoff mainly occurs in the high mountains of the western United States (Fig. 7a), when the runoff is much smaller. Humid regions such as the northeastern United States and the European Mediterranean area have quite high R^2 values, while lower values are observed in the Semi-arid (0.2≤Aridity Index<0.5) and the Dry sub-humid (0.5≤Aridity Index<0.65) regions, which are mainly located in the western and midwestern United States (Fig. 7e-h). There is low NSE scores in the watersheds where runoff is unusually under-estimated or over-estimated (Fig. 7i-l), especially in the western United States."

Comment 29:

Line300 "Discussion"

This section sometimes a bit wordy, but overall I like your analysis. Food for thought.

Response:

Thank you for your positive comments.

Comment 30:

Line327 "paradox"

It may be a contradiction, but it is by no means a paradox.

Response:

Thank you, according to your comments, we have changed the "paradox" to "confusion".

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Supplement 3: The runoff simulation and verification results for each GRDC watershed

AREA-the drainage area (km^2);

R_GRDC-the average annual observed runoff from 2000 to 2016 (mm yr^{-1});

R_PwM-the average annual simulated runoff by PwM from 2000 to 2016 (mm yr^{-1});

n- the length of time

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
6607855	53.7	0.18	51.11	485.44	289.95	0.81	-0.82	-0.40	17
6607560	87.8	0.08	50.95	450.62	232.86	0.85	-0.90	-0.48	17
6337503	103	8.73	51.38	524.96	398.44	0.85	-0.51	-0.24	17
4215090	117	-119.32	49.25	215.50	118.32	0.27	-1.88	-0.45	17
6335300	141	9.34	49.23	298.31	385.17	0.65	-1.47	0.29	17
6233550	164	16.29	62.66	341.89	303.56	0.93	0.77	-0.11	17
6608240	178.7	-3.12	51.53	1077.31	840.85	0.93	-0.06	-0.22	17
6934200	187	9.61	55.90	462.32	400.69	0.62	0.13	-0.13	17
6606790	190.3	0.48	51.74	196.14	225.57	0.69	0.35	0.15	17
6606700	198	0.14	52.13	142.82	189.23	0.47	-0.80	0.33	17
6457880	218	18.64	50.77	198.98	199.56	0.72	-0.63	0.00	17
6606950	238.2	0.85	51.90	165.56	204.68	0.77	0.16	0.24	17
6604240	245.5	-4.81	55.26	957.56	895.38	0.90	0.76	-0.06	17
6457280	246	18.11	51.26	132.81	135.67	0.62	-0.26	0.02	17
6233150	259.7	13.12	56.72	720.79	578.85	0.84	-0.06	-0.20	17
6935410	261	9.32	47.41	1207.28	954.02	0.83	-1.81	-0.21	17
1160220	265	19.29	-32.78	151.45	14.11	0.66	-2.35	-0.91	17
1160720	299	30.10	-29.50	209.55	145.24	0.54	0.04	-0.31	17
6603310	304.3	-6.51	54.76	889.34	776.17	0.90	0.20	-0.13	17
6242420	305.9	15.57	48.44	201.12	283.42	0.70	-0.42	0.41	17
4234550	321	-79.38	45.67	585.45	555.10	0.64	0.60	-0.05	17
1160710	358	30.15	-29.44	184.30	138.89	0.20	-1.38	-0.25	17
6457260	360	17.74	52.24	72.08	113.79	0.58	-0.98	0.58	17
6457380	395	16.59	52.57	66.82	158.13	0.29	-8.28	1.37	17
4208861	425	-111.73	55.18	152.45	106.44	0.30	-1.34	-0.30	17
6935320	443	7.74	46.97	875.37	804.38	0.88	0.69	-0.08	17
6457290	447	18.08	51.65	113.93	149.99	0.62	0.05	0.32	17
4213350	453	-108.13	49.71	33.82	27.33	0.00	-0.78	0.32	17
6935402	493	9.07	47.41	1274.77	986.15	0.83	-0.92	-0.23	17
6233870	494.3	23.31	66.11	354.20	330.98	0.91	0.86	-0.07	17
1196700	518	30.80	-24.68	334.89	184.54	0.73	-0.04	-0.45	17
1160450	523	23.31	-33.74	189.91	41.87	0.55	-0.51	-0.78	17
1160680	545	29.47	-29.78	439.56	238.31	0.47	-2.28	-0.46	17
4231680	557	-66.68	45.67	772.98	671.45	0.87	0.62	-0.13	17
6605330	569.8	-1.64	55.34	511.24	373.16	0.93	-0.26	-0.27	17
6606850	578	0.94	51.97	173.07	210.42	0.71	-0.09	0.22	17
6457230	592	18.74	51.39	126.81	145.83	0.76	0.54	0.15	17
4146320	603.5	-121.06	36.27	12.98	41.50	0.35	-8.63	2.40	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
6140600	624	15.91	50.04	185.38	231.38	0.55	-0.38	0.25	17
6229100	624.1	11.54	58.88	640.83	533.66	0.73	0.24	-0.17	17
4584200	639	-77.76	18.08	1078.52	745.71	0.45	-1.77	-0.31	17
4220431	655	-109.81	49.23	4.35	25.12	0.01	-73.93	8.18	17
1160300	657	19.30	-33.38	115.25	29.89	0.68	-1.55	-0.74	17
6457340	663	16.52	52.16	65.65	153.49	0.36	-6.66	1.34	17
4231800	668	-65.37	46.07	670.73	671.34	0.86	0.84	0.00	17
6934350	680	8.88	55.32	466.98	439.65	0.74	0.46	-0.06	17
1160650	715	29.83	-30.74	205.21	231.61	0.79	0.37	0.13	17
6246700	727.7	15.47	47.53	605.49	551.68	0.61	0.29	-0.09	17
1160301	753	19.27	-33.42	315.64	29.89	0.60	-3.93	-0.89	17
4123382	766.6	-82.62	35.30	1024.71	900.35	0.82	0.62	-0.12	17
6140500	791	15.28	50.64	625.14	465.49	0.47	-1.14	-0.26	17
6457240	811	18.98	51.47	157.83	157.29	0.61	0.36	0.00	17
4208465	819	-118.49	58.59	83.49	85.10	0.29	0.23	0.05	17
6142640	827	18.91	49.06	376.21	383.24	0.62	0.40	0.02	17
6458203	836	19.51	49.87	488.42	407.92	0.90	0.56	-0.16	17
4213050	859	-114.93	52.27	173.70	187.81	0.39	0.30	0.08	17
4123335	903.9	-79.62	39.07	805.74	681.01	0.85	0.25	-0.15	17
1199100	910	30.59	-26.28	45.58	78.22	0.63	-0.56	0.72	17
6607130	916.9	-4.22	50.53	796.19	740.40	0.93	0.84	-0.07	17
4220300	928	-105.71	48.99	23.18	15.19	0.06	-0.45	-0.33	17
6335125	954	8.03	48.39	732.19	712.89	0.83	0.81	-0.03	17
6142551	955	18.79	49.30	512.34	453.34	0.71	0.14	-0.12	17
4123083	968.7	-83.36	36.85	651.66	617.47	0.87	0.83	-0.05	17
6603320	970.2	-6.74	54.41	625.68	615.69	0.90	0.89	-0.02	17
6233800	1012	21.80	66.16	406.50	322.30	0.95	0.43	-0.21	17
4123265	1012.7	-81.71	38.18	487.66	552.09	0.82	0.48	0.13	17
4123275	1023.1	-81.01	37.54	422.07	518.46	0.79	0.02	0.23	17
6934100	1040	8.72	55.95	501.49	424.79	0.49	-1.23	-0.15	17
1196300	1046	27.48	-24.16	40.91	23.45	0.67	0.36	-0.35	17
4147450	1046.4	-72.19	41.71	635.02	503.56	0.85	0.41	-0.21	17
4220502	1050	-112.54	49.01	80.04	114.90	0.44	-0.27	0.59	17
4134350	1077.4	-84.71	43.63	297.76	239.37	0.50	-1.63	-0.20	17
6935401	1085	9.17	47.53	1078.67	918.10	0.83	-0.12	-0.15	17
6142680	1107	19.60	49.09	566.54	518.21	0.79	0.19	-0.09	17
4208857	1110	-112.46	55.20	98.55	97.27	0.06	-0.08	-0.01	17
4208750	1140	-115.78	54.20	215.67	166.55	0.48	0.18	-0.23	17
4235191	1160	-82.01	42.65	333.47	350.13	0.56	0.47	0.05	17
4133100	1165.5	-87.20	45.76	234.41	277.00	0.59	0.15	0.18	17
6337504	1202	8.90	51.16	458.60	369.93	0.79	-0.20	-0.19	17
4123240	1225.1	-84.81	38.27	539.25	614.50	0.78	0.60	0.14	17
4123225	1232.8	-86.23	38.24	583.66	539.53	0.76	0.55	-0.08	17
6457320	1247	16.62	52.11	75.83	166.99	0.46	-5.88	1.20	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4244985	1250	-64.59	44.45	935.83	877.31	0.85	0.75	-0.06	17
2421500	1250	52.05	35.86	29.22	31.86	0.08	-0.30	0.10	17
6457955	1255	18.16	51.31	127.09	138.90	0.72	-0.59	0.09	17
6142300	1275	17.75	49.53	362.54	313.91	0.72	0.52	-0.13	17
6854301	1283	23.76	63.98	306.94	308.73	0.85	0.85	0.01	17
4123320	1284.6	-80.54	40.68	391.98	464.85	0.86	0.55	0.19	17
6934250	1290	9.67	56.24	422.34	351.20	0.39	-1.98	-0.17	17
6233350	1332.7	16.16	57.01	233.62	231.66	0.70	0.59	-0.01	17
4115224	1333.9	-119.14	44.89	164.26	93.61	0.27	-1.19	-0.43	17
4213315	1350	-115.08	52.66	155.10	163.29	0.36	0.18	0.05	17
4244960	1350	-61.98	45.17	995.03	891.04	0.68	0.26	-0.10	17
4123510	1351.9	-85.15	39.59	444.29	507.24	0.60	0.11	0.14	17
6605565	1363	-1.34	54.16	522.96	312.31	0.87	-2.18	-0.40	17
6594050	1376	35.63	33.05	263.77	22.02	0.64	-3.52	-0.92	17
4134500	1393.4	-84.18	43.01	261.67	310.37	0.44	-0.64	0.19	17
4220310	1400	-105.41	49.00	5.03	19.61	0.30	-5.08	2.91	17
6342520	1400	11.19	48.89	229.44	307.29	0.61	-1.11	0.34	17
6341500	1403	13.31	53.79	121.99	172.56	0.37	-4.06	0.41	17
6140450	1421	15.10	49.74	216.05	203.75	0.57	0.31	-0.06	17
4150320	1421.9	-97.45	29.22	72.58	123.33	0.63	-1.38	0.73	17
4123351	1424.5	-78.39	41.96	629.15	523.97	0.85	0.17	-0.17	17
4213340	1430	-108.48	49.85	28.06	45.59	0.11	-2.80	0.66	17
4121126	1432.3	-102.47	46.16	23.38	14.45	0.01	-0.43	-0.38	17
4231650	1450	-66.61	46.13	862.02	724.19	0.78	0.33	-0.16	17
6337505	1452	9.09	51.16	428.98	369.93	0.70	-0.17	-0.14	17
4208889	1460	-111.56	57.19	105.92	74.27	0.44	-0.10	-0.30	17
6233700	1465.2	18.29	63.44	372.54	359.31	0.81	0.79	-0.04	17
1160500	1479	26.08	-33.33	5.09	34.17	0.43	-35.77	5.71	17
4234600	1520	-79.28	44.71	496.19	433.46	0.44	0.10	-0.13	17
4213605	1520	-99.33	49.11	61.61	54.05	0.01	-0.65	-0.07	17
4213172	1530	-94.46	50.36	280.81	283.64	0.64	0.63	0.01	17
1160750	1546	30.25	-29.07	126.68	151.24	0.63	0.20	0.19	17
4132300	1546.2	-90.69	46.49	348.96	299.13	0.70	0.54	-0.14	17
6142100	1559	16.98	49.76	305.64	280.95	0.52	0.08	-0.08	17
4143710	1574.7	-73.47	44.68	589.96	552.17	0.65	0.38	-0.06	17
4213770	1580	-96.43	50.09	208.48	205.34	0.44	0.40	-0.01	17
4143500	1585	-74.78	44.86	649.18	523.50	0.47	-2.17	-0.19	17
6605420	1586	-0.89	54.02	369.55	400.25	0.80	0.28	0.08	17
6357502	1621	15.00	51.16	292.86	305.23	0.68	0.59	0.04	17
3650221	1663	-46.64	-1.77	1354.48	1311.08	0.71	0.59	-0.03	17
4123235	1683.5	-84.28	39.87	397.35	460.94	0.68	0.38	0.16	17
4208983	1690	-109.79	58.32	167.25	109.70	0.11	-3.22	-0.34	17
6935400	1696	8.67	47.60	867.90	823.35	0.87	0.76	-0.05	17
6604201	1704.2	-4.07	55.80	880.77	693.29	0.94	-0.11	-0.21	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4213435	1720	-97.51	51.36	161.31	134.38	0.12	0.06	-0.17	17
1160700	1744	29.90	-29.75	306.18	164.04	0.67	-1.11	-0.46	17
4135500	1774.2	-81.23	41.72	533.09	558.36	0.77	0.74	0.05	17
4143770	1776.7	-73.08	44.68	728.53	732.91	0.75	0.70	0.01	17
4147475	1784.5	-72.51	42.16	493.32	546.40	0.82	0.60	0.11	17
4151300	1784.5	-104.06	32.02	5.25	6.89	0.03	-0.53	0.43	17
6545300	1841.9	15.18	46.09	652.32	604.28	0.90	0.80	-0.07	17
6603120	1843.8	-7.46	54.81	1026.25	782.48	0.94	-0.92	-0.24	17
4220402	1850	-109.52	49.29	13.61	20.31	0.02	-1.37	0.52	17
4213835	1860	-115.43	52.36	250.32	233.30	0.31	0.19	-0.07	17
4123341	1870	-79.68	39.12	875.50	681.01	0.85	-0.49	-0.22	17
4148125	1898.5	-77.58	35.43	348.13	352.45	0.64	0.64	0.01	17
4208770	1900	-115.41	55.32	204.52	225.62	0.71	0.65	0.10	17
4135300	1901.1	-82.91	42.60	317.95	319.23	0.54	0.38	0.00	17
4152500	1908.8	-110.11	31.38	15.91	18.67	0.44	0.26	0.40	17
4213530	1920	-102.07	52.00	142.41	114.72	0.40	0.17	-0.19	17
6335290	1929	9.28	49.26	374.81	394.64	0.77	0.55	0.05	17
4146200	1929.5	-123.33	39.71	623.25	346.95	0.80	-0.27	-0.44	17
3652010	1960	-37.20	-10.68	46.27	36.71	0.04	-0.89	-0.21	17
4213131	1980	-113.88	50.60	189.36	143.78	0.73	0.51	-0.24	17
4213540	2000	-101.32	50.96	73.11	99.18	0.15	-1.65	0.36	17
4208610	2010	-117.67	56.52	70.99	115.56	0.24	-3.51	0.66	17
4123135	2043.5	-86.26	40.78	368.18	414.98	0.48	-0.28	0.13	17
6854590	2045	29.57	64.21	421.38	333.42	0.88	0.00	-0.21	17
4147502	2051.3	-73.99	43.70	767.36	648.64	0.77	0.11	-0.15	17
4122170	2051.3	-95.82	40.39	142.97	187.59	0.69	0.44	0.31	17
4146130	2053.8	-122.59	41.82	67.00	42.65	0.29	-1.35	-0.36	17
4125918	2053.9	-91.20	36.64	348.53	474.61	0.42	-1.19	0.36	17
4147463	2069.4	-71.63	44.75	762.78	656.11	0.77	-0.30	-0.14	17
6142520	2094	18.17	48.53	203.71	289.72	0.55	-2.25	0.42	17
3650930	2100	-35.96	-8.28	32.77	105.28	0.59	-8.99	2.54	17
4213265	2110	-101.15	52.26	124.86	100.99	0.55	0.42	-0.19	17
3651520	2111	-44.51	-14.43	104.15	107.71	0.28	-5.66	0.03	17
4147721	2113.4	-78.02	40.49	463.30	452.04	0.88	0.84	-0.02	17
4147905	2116	-77.36	39.41	427.01	459.15	0.77	0.67	0.08	17
4150515	2118.6	-98.03	31.09	70.40	133.71	0.56	-0.65	0.90	17
4133651	2134.2	-85.20	42.32	322.16	316.35	0.24	-0.94	-0.02	17
6233100	2160.2	12.31	57.24	606.70	469.06	0.79	-0.15	-0.23	17
6457990	2163	14.81	53.56	188.55	182.91	0.18	-0.25	-0.03	17
4150315	2170.4	-97.65	29.66	199.58	232.99	0.77	0.58	0.17	17
6605300	2175.6	-1.94	54.95	691.17	613.62	0.92	0.62	-0.11	17
4119288	2185.9	-93.80	42.44	269.31	227.81	0.75	0.65	-0.15	17
4208480	2200	-122.36	56.46	322.61	179.56	0.39	-3.68	-0.44	17
4220401	2210	-109.47	49.16	10.75	20.31	0.01	-2.13	0.94	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
6609400	2210	-1.94	52.09	253.84	306.72	0.82	0.19	0.21	17
4123136	2217	-86.57	41.16	365.85	361.85	0.28	-0.19	-0.01	17
4203220	2220	-139.64	63.76	110.86	93.31	0.41	-0.56	-0.15	17
4123200	2222.2	-86.02	40.04	436.56	485.67	0.65	0.44	0.11	17
4213060	2230	-114.86	52.25	256.17	264.40	0.70	0.69	0.03	17
4231621	2230	-67.21	47.17	733.70	716.47	0.90	0.89	-0.02	17
6545200	2238.12	15.46	45.87	720.18	718.94	0.91	0.91	0.00	17
4121350	2255.9	-95.78	41.64	205.68	229.10	0.66	0.60	0.11	17
3649440	2259	-50.99	-16.49	481.48	394.38	0.11	-0.54	-0.18	17
4244840	2270	-66.89	47.83	594.67	581.59	0.51	0.38	-0.02	17
4151651	2271.4	-106.73	36.58	154.19	26.89	0.02	-13.83	-0.83	17
4213840	2280	-93.45	57.02	203.56	165.26	0.70	0.34	-0.19	17
4149415	2292.2	-86.98	33.71	541.97	566.65	0.81	0.76	0.05	17
4121330	2294.7	-96.31	42.58	149.62	149.36	0.54	0.53	0.00	17
4116340	2318.1	-113.64	44.94	84.11	8.36	0.05	-12.75	-0.90	17
4214295	2330	-109.39	55.71	130.14	116.72	0.00	-0.85	-0.10	17
4119295	2338.8	-90.99	39.01	294.51	363.46	0.80	0.62	0.23	17
4123330	2367.3	-80.04	39.15	741.53	769.14	0.92	0.88	0.04	17
4115290	2393.2	-120.01	47.84	772.30	507.83	0.19	-3.33	-0.34	17
1159601	2397	26.35	-31.00	13.16	20.15	0.77	0.59	0.54	17
6233400	2428.2	15.39	63.52	439.05	322.61	0.69	-0.74	-0.27	17
4113420	2432	-101.57	48.37	15.04	28.87	0.01	-0.80	0.94	17
4123280	2442.4	-82.09	39.33	387.71	446.39	0.78	0.55	0.15	17
6458924	2462	21.71	52.50	134.25	170.27	0.54	-0.84	0.27	17
4125010	2483.8	-94.92	35.92	360.72	354.87	0.78	0.77	-0.02	17
4151400	2494.2	-104.74	33.29	7.54	17.34	0.81	-63.41	7.72	17
4122111	2501.9	-100.53	41.78	80.40	67.74	0.03	-178.86	-0.16	17
4150510	2507.1	-97.56	31.79	91.98	131.43	0.60	0.28	0.44	17
6337508	2523	9.72	51.00	261.05	314.48	0.68	-0.61	0.20	17
1160600	2530	27.39	-33.19	55.24	65.39	0.57	0.15	0.18	17
4122212	2548.6	-98.07	40.34	37.34	68.35	0.47	-8.27	0.83	17
4143310	2553.7	-75.38	44.60	659.64	550.14	0.79	-0.26	-0.17	17
4208940	2560	-116.63	53.47	216.49	221.68	0.61	0.54	0.02	17
4115344	2577.1	-112.74	46.40	80.34	27.57	0.15	-3.63	-0.66	17
4147491	2580	-73.49	41.65	652.04	603.45	0.87	0.80	-0.07	17
4220400	2580	-109.42	49.01	9.85	20.31	0.00	-2.11	1.13	17
6457220	2597	16.84	52.67	83.26	147.46	0.34	-3.83	0.77	17
4119230	2597.8	-90.16	41.49	274.15	369.62	0.64	0.12	0.35	17
4208445	2610	-117.19	59.58	101.72	70.52	0.37	0.03	-0.30	17
4119050	2615.9	-94.88	46.64	158.75	118.66	0.11	-5.53	-0.25	17
4236700	2620	-77.42	44.25	370.15	382.56	0.74	0.50	0.03	17
4152652	2621.1	-106.94	38.54	204.18	40.85	0.09	-5.91	-0.80	17
4122105	2628.9	-96.52	41.71	127.35	132.51	0.36	0.14	0.04	17
4213557	2630	-99.90	50.36	79.80	101.90	0.15	-0.47	0.28	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4123355	2662.5	-79.96	41.44	713.72	567.59	0.82	-0.28	-0.20	17
4135100	2698.8	-83.53	41.96	278.62	281.91	0.34	0.05	0.01	17
4208843	2700	-111.25	58.36	214.92	116.20	0.28	-12.31	-0.46	17
4115451	2716.9	-114.14	45.97	273.46	49.95	0.34	-9.36	-0.82	17
4122620	2719.5	-96.46	40.97	121.30	160.96	0.66	0.06	0.33	17
4220501	2720	-112.08	49.14	105.31	72.13	0.45	-5.64	-0.32	17
4119263	2729.9	-92.67	43.06	300.51	250.99	0.43	0.24	-0.16	17
4147505	2732.5	-73.87	43.31	760.31	674.64	0.69	0.22	-0.11	17
4119321	2776.5	-90.28	40.71	275.31	369.38	0.61	0.10	0.34	17
4126301	2815.3	-95.91	34.27	243.40	237.66	0.79	0.78	-0.02	17
6338120	2842	7.60	52.10	275.05	322.14	0.75	-0.42	0.17	17
4119220	2846.4	-89.00	42.20	298.33	389.57	0.68	0.04	0.31	17
4125075	2864.5	-102.96	36.93	7.98	12.29	0.01	-16.06	4.10	17
4119090	2874.9	-94.04	44.11	254.32	242.16	0.26	0.14	-0.05	17
4122260	2900.8	-93.20	38.99	288.59	357.39	0.78	0.59	0.24	17
6140300	2913	14.14	49.31	271.25	246.20	0.76	0.69	-0.09	17
4120322	2913.8	-109.84	46.43	33.09	29.42	0.28	0.22	-0.11	17
4123110	2929.3	-88.30	38.64	379.36	474.67	0.54	-0.16	0.25	17
4123278	2929.3	-80.98	36.65	555.16	487.51	0.57	0.43	-0.12	17
4125917	2937	-91.11	36.35	369.81	474.61	0.47	-0.47	0.28	17
4147650	2970.7	-75.65	40.24	629.22	569.85	0.92	0.81	-0.09	17
6337506	2975	9.50	51.19	253.73	314.48	0.64	-1.30	0.24	17
4232600	2980	-88.38	48.91	266.25	294.57	0.65	0.12	0.11	17
4125020	3014.8	-94.56	37.24	298.69	413.53	0.81	0.41	0.38	17
4208858	3080	-111.86	55.01	80.73	106.44	0.34	-0.86	0.32	17
6854620	3109	25.09	65.69	445.28	340.45	0.82	0.21	-0.24	17
4244850	3160	-67.49	47.66	718.79	601.85	0.66	-0.05	-0.16	17
3650370	3180	-43.95	-4.50	312.73	438.70	0.62	0.15	0.40	17
6340700	3184	13.40	51.52	125.99	230.43	0.38	-3.92	0.83	17
4121111	3185.7	-102.06	47.16	22.84	24.30	0.42	0.29	0.06	17
4133751	3185.7	-84.56	42.75	287.18	251.89	0.30	-0.51	-0.12	17
3650620	3200	-38.99	-7.30	41.32	86.91	0.47	-4.95	2.62	17
4120960	3203.4	-105.35	44.93	5.92	16.02	0.16	-7.05	1.74	17
4121431	3211.6	-102.31	46.74	27.37	13.53	0.10	-0.18	-0.51	17
4125943	3224.6	-90.39	36.76	418.78	499.03	0.62	0.08	0.19	17
4122270	3237.5	-95.27	38.62	178.95	242.80	0.80	0.53	0.36	17
4119318	3240	-88.93	41.21	284.57	367.67	0.59	0.09	0.29	17
4135210	3240.1	-83.16	41.31	384.28	375.95	0.60	0.59	-0.02	17
6213800	3253	-2.58	40.70	122.52	67.58	0.23	-1.06	-0.45	17
1196600	3256	29.26	-26.01	50.36	58.33	0.68	0.57	0.20	17
6605570	3315	-1.14	53.99	535.67	434.93	0.92	0.26	-0.19	17
4213815	3350	-101.11	53.15	156.36	127.77	0.79	0.66	-0.18	17
4116480	3354.1	-112.47	43.13	24.44	43.34	0.01	-10.19	0.78	17
4123245	3364.4	-85.71	37.77	505.38	642.46	0.84	0.14	0.27	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4115231	3369.6	-120.43	47.50	812.60	453.93	0.29	-5.70	-0.44	17
4120301	3385.1	-111.55	47.93	13.61	10.44	0.10	-0.27	-0.22	17
4119283	3387.7	-94.19	42.73	221.39	173.95	0.40	0.15	-0.21	17
4151805	3418.8	-106.47	37.68	198.80	52.91	0.41	-5.90	-0.73	17
4119210	3434.3	-89.62	42.31	314.75	413.82	0.70	-0.12	0.31	17
4122165	3434.3	-95.58	40.87	230.01	251.86	0.72	0.69	0.10	17
4125810	3436.9	-97.39	37.84	83.69	77.91	0.39	-0.14	-0.07	17
4146210	3465.4	-122.92	38.51	449.69	177.83	0.50	-1.11	-0.60	17
4122180	3468	-95.60	40.04	122.53	164.91	0.79	0.49	0.35	17
4213140	3470	-105.40	50.40	27.63	20.29	0.03	-0.28	-0.25	17
4133250	3470.6	-88.95	43.95	317.74	329.34	0.65	0.49	0.04	17
4132800	3470.6	-89.21	46.72	307.04	360.02	0.56	-0.30	0.17	17
4119313	3501.7	-86.97	41.22	363.60	390.90	0.23	-0.46	0.08	17
4147111	3525	-71.19	44.44	713.00	620.09	0.80	0.17	-0.13	17
4213111	3530	-112.84	49.57	118.05	85.85	0.52	0.34	-0.27	17
4148325	3553.5	-80.18	35.15	268.96	413.47	0.70	-0.58	0.54	17
6458863	3561	21.79	53.39	166.11	225.94	0.14	-4.92	0.36	17
4208580	3570	-120.57	55.96	92.15	161.53	0.41	-1.45	0.75	17
6335350	3571	8.35	50.55	287.16	361.68	0.81	-0.70	0.26	17
4113315	3574.2	-96.27	47.89	96.76	99.56	0.25	-0.97	0.03	17
4213900	3580	-113.01	51.29	28.77	43.91	0.39	-1.23	0.53	17
4207100	3600	-125.01	54.01	182.33	160.62	0.28	0.21	-0.12	17
6233250	3664.5	14.13	56.11	306.55	318.00	0.77	0.72	0.04	17
4148070	3680.4	-77.16	36.77	304.80	436.36	0.81	0.07	0.43	17
4213780	3700	-95.96	49.94	170.71	221.51	0.61	0.06	0.30	17
4122154	3706.3	-106.35	40.93	96.81	17.85	0.00	-2.28	-0.82	17
4133701	3711.5	-85.26	43.90	260.71	221.52	0.45	-1.05	-0.15	17
3650511	3720	-40.82	-3.11	205.93	128.46	0.79	0.71	-0.12	17
4213021	3720	-111.59	50.86	5.28	8.24	0.00	-1.97	0.57	17
4121162	3729.6	-102.84	43.02	10.63	6.99	0.08	-0.17	-0.33	17
4213341	3730	-107.66	50.50	15.22	16.13	0.00	-1.20	0.06	17
4208245	3740	-126.46	59.66	236.98	166.92	0.31	-2.76	-0.30	17
6338130	3740	7.44	52.29	288.64	322.14	0.77	-0.26	0.12	17
4118105	3755.5	-119.25	39.30	63.78	4.73	0.35	-1.41	-0.93	17
4133801	3758.1	-85.95	44.26	417.30	240.91	0.11	-21.38	-0.42	17
6233780	3780.8	21.96	66.02	405.80	334.20	0.94	0.45	-0.18	17
4113340	3833.2	-97.05	46.91	51.88	84.55	0.17	-0.43	0.63	17
4127150	3833.2	-88.98	35.28	494.93	598.76	0.90	0.42	0.21	17
4147710	3841	-75.85	42.22	650.16	620.89	0.84	0.78	-0.05	17
4147903	3848.7	-78.65	39.45	316.67	389.62	0.86	0.31	0.23	17
4123137	3926.4	-88.02	38.94	338.46	384.02	0.45	0.30	0.13	17
4119252	3967.9	-92.91	42.06	289.45	232.78	0.79	0.58	-0.20	17
4213134	3990	-113.82	50.79	161.75	161.59	0.80	0.79	0.00	17
6335602	3995	9.42	48.71	398.08	482.42	0.77	-0.45	0.21	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4147490	3999	-73.17	41.39	651.51	581.68	0.88	0.75	-0.11	17
4119150	4001.6	-91.26	42.74	303.49	305.63	0.76	0.75	0.01	17
6608501	4010	-2.69	51.79	595.37	534.11	0.95	0.78	-0.10	17
6335115	4013	7.91	49.91	230.18	269.19	0.75	0.37	0.17	17
4119510	4022.3	-90.63	42.09	323.05	402.22	0.70	0.30	0.25	17
4146145	4053.4	-121.85	42.59	100.36	17.42	0.00	-5.50	-0.83	17
6357501	4125	14.71	51.97	202.18	196.19	0.42	0.05	-0.03	17
4147950	4133.6	-77.53	38.31	361.81	418.98	0.81	0.65	0.16	17
1159900	4152	29.24	-27.17	57.99	52.64	0.65	0.64	-0.09	17
4123082	4162.1	-84.16	36.74	571.86	647.90	0.89	0.74	0.13	17
4123350	4164.7	-78.71	42.16	601.44	521.20	0.85	0.36	-0.13	17
4119286	4193.2	-94.38	41.99	227.89	178.51	0.74	0.52	-0.22	17
4123270	4193.2	-80.81	37.64	499.89	471.82	0.86	0.81	-0.06	17
4120210	4203.6	-109.23	48.65	7.51	16.47	0.00	-1.02	1.25	17
4213531	4230	-101.06	52.20	110.93	85.64	0.26	-0.11	-0.23	17
6144300	4232	21.35	48.61	231.54	285.35	0.85	0.44	0.23	17
4119271	4234.7	-92.66	41.36	297.83	280.08	0.92	0.85	-0.06	17
4119322	4236.7	-90.34	40.49	279.71	369.38	0.64	0.24	0.32	17
4214280	4250	-95.67	57.66	218.94	146.05	0.44	-0.48	-0.33	17
6335800	4251	10.87	49.95	330.05	343.82	0.70	0.45	0.04	17
4119442	4273.5	-91.26	45.45	321.95	381.20	0.70	0.09	0.18	17
6854320	4283	24.38	64.34	303.74	275.31	0.87	0.74	-0.09	17
4115250	4291.6	-118.73	46.03	122.58	41.21	0.29	-4.38	-0.66	17
4119262	4302	-92.46	42.65	312.29	250.99	0.52	0.29	-0.20	17
6337512	4302	10.20	51.12	288.19	304.42	0.52	-0.53	0.06	17
6457956	4304	17.94	51.91	111.67	132.35	0.74	0.20	0.19	17
4125911	4317.5	-91.01	36.99	412.34	461.31	0.72	0.44	0.12	17
4122255	4325.3	-93.64	40.09	248.38	287.12	0.88	0.83	0.16	17
4123220	4333.1	-85.89	37.27	568.80	603.66	0.80	0.71	0.06	17
6458406	4341	20.69	49.63	508.08	508.06	0.81	0.78	0.00	17
4113600	4351.2	-93.55	48.40	208.98	221.81	0.45	0.39	0.06	17
4121145	4377.1	-104.94	44.33	4.11	13.29	0.29	-14.77	2.25	17
4213730	4400	-97.67	53.79	170.83	180.32	0.49	0.35	0.06	17
4213101	4400	-113.82	49.56	271.78	146.75	0.61	-1.69	-0.46	17
4244770	4400	-54.85	49.01	914.57	723.70	0.63	-1.17	-0.21	17
4123205	4421.1	-85.93	39.20	469.68	512.63	0.48	0.10	0.09	17
6233360	4446	16.44	57.15	221.81	236.07	0.57	0.34	0.06	17
4134700	4504	-83.44	44.44	261.80	211.48	0.54	-7.33	-0.19	17
4125942	4529.9	-90.54	36.40	401.55	512.72	0.68	-0.20	0.28	17
4121125	4532.5	-101.33	46.09	18.79	15.58	0.00	-0.55	-0.15	17
4122190	4558.4	-94.70	39.69	226.76	274.15	0.83	0.73	0.21	17
4125200	4576.5	-94.65	35.17	381.15	443.18	0.87	0.72	0.16	17
2421400	4578	49.51	36.62	119.34	122.59	0.00	-1.10	0.03	17
4116471	4584.3	-111.67	43.96	334.01	80.49	0.14	-17.03	-0.76	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4120111	4584.3	-106.76	45.14	72.15	18.03	0.64	-2.12	-0.75	17
4119445	4584.3	-91.93	44.89	291.36	259.92	0.59	-0.09	-0.11	17
4115235	4589.5	-119.99	48.08	297.24	108.94	0.46	-4.07	-0.63	17
4119312	4607.6	-87.34	41.19	363.67	395.06	0.25	-0.43	0.09	17
4113410	4636.1	-103.08	48.98	12.25	25.37	0.09	-0.51	1.18	17
4213935	4650	-104.16	53.59	133.36	93.63	0.08	-0.25	-0.30	17
4133401	4662	-88.08	45.88	286.16	332.18	0.52	-0.37	0.16	17
6157100	4665	18.33	49.92	276.38	279.14	0.82	0.77	0.01	17
4119325	4672.4	-89.74	40.14	292.32	381.34	0.69	0.25	0.30	17
4120220	4675	-109.84	48.53	7.07	11.61	0.51	0.19	0.67	17
4214297	4730	-108.04	55.41	86.63	104.38	0.05	-1.21	0.20	17
3650630	4730	-39.36	-5.58	37.96	40.94	0.69	0.62	0.08	17
4150462	4804.5	-99.74	30.51	31.32	67.34	0.51	-7.18	1.15	17
4125080	4814.8	-97.28	36.81	130.21	141.71	0.80	0.73	0.09	17
4152201	4827.8	-108.54	33.06	27.54	10.57	0.34	-1.08	-0.62	17
4136500	4827.8	-75.92	43.99	879.68	709.74	0.81	-1.06	-0.19	17
4133501	4832.9	-85.76	41.80	338.82	374.49	0.26	-1.04	0.11	17
6854900	4833	21.84	63.14	285.79	290.07	0.79	0.78	0.02	17
4126352	4853.7	-99.39	33.70	21.55	60.18	0.60	-20.20	1.90	17
4208865	4860	-110.86	55.84	142.32	107.30	0.08	-0.51	-0.25	17
4113330	4869.2	-96.58	46.16	78.69	113.52	0.32	-0.32	0.48	17
4125070	4869.2	-96.99	37.22	217.00	229.91	0.91	0.90	0.06	17
4213880	4870	-92.72	48.85	289.64	311.77	0.44	0.08	0.08	17
4147651	4902.9	-75.19	39.97	591.61	569.85	0.91	0.89	-0.04	17
6338110	4981	7.25	52.60	286.98	308.85	0.70	-0.60	0.08	17
4127202	5024.6	-89.09	38.96	316.51	394.10	0.53	0.13	0.25	17
3650881	5092	-36.50	-7.71	85.92	48.83	0.52	-0.22	0.63	17
4208295	5100	-129.55	60.21	350.08	274.91	0.24	-1.30	-0.21	17
4121102	5102.3	-103.97	45.55	23.23	10.12	0.42	0.01	-0.56	17
3649450	5140	-51.40	-16.42	476.75	420.72	0.19	-0.78	-0.12	17
6337511	5166	9.98	51.27	269.44	290.93	0.55	-1.00	0.08	17
6545101	5176.79	15.09	46.12	1015.13	935.08	0.89	0.79	-0.08	17
6172050	5180	24.77	58.46	315.40	319.83	0.41	-0.02	0.01	17
4120300	5205.9	-110.51	47.93	8.89	5.17	0.09	-0.08	-0.31	17
4125565	5226.6	-96.07	35.68	130.87	147.48	0.73	0.68	0.13	17
4125910	5278.4	-90.85	36.63	488.49	461.31	0.66	0.52	-0.06	17
6337509	5304	9.68	52.39	286.89	297.06	0.68	0.47	0.04	17
2421800	5310	55.16	37.26	29.10	23.30	0.10	-0.09	-0.20	17
4113360	5361.3	-98.71	47.81	31.33	54.25	0.16	-2.14	0.73	17
4213056	5370	-112.67	50.14	12.62	17.02	0.37	-5.67	0.35	17
4119430	5387.2	-91.29	44.06	304.70	251.30	0.78	0.32	-0.18	17
4113310	5387.2	-96.79	46.47	58.96	96.12	0.18	-0.70	0.63	17
4214400	5390	-91.59	51.17	319.64	327.18	0.60	0.60	0.02	17
4126351	5402.7	-99.14	33.76	11.17	66.16	0.12	-175.02	4.92	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4119315	5415.7	-87.82	41.01	354.58	406.99	0.48	0.23	0.15	17
4126750	5444.2	-92.03	33.70	436.01	500.92	0.83	0.73	0.15	17
4150331	5472.7	-98.06	28.95	106.74	140.15	0.77	0.00	0.31	17
6337513	5487	9.71	51.41	271.54	277.80	0.57	-0.77	0.02	17
1197300	5499	30.97	-26.03	65.25	95.90	0.65	0.04	0.47	17
4125100	5563.3	-99.34	38.20	10.85	16.60	0.08	-38.10	4.92	17
4208890	5570	-111.69	57.21	84.23	94.12	0.06	-0.42	0.12	17
4215050	5590	-120.15	49.38	261.03	280.62	0.46	0.31	0.08	17
4148110	5654	-77.53	35.89	306.31	367.37	0.60	0.18	0.20	17
4213375	5660	-115.36	52.91	278.65	233.59	0.36	-0.13	-0.16	17
4115310	5698	-118.76	48.98	239.25	164.32	0.31	-1.75	-0.31	17
4123277	5703.2	-80.74	36.94	474.26	483.80	0.66	0.63	0.02	17
4147701	5780.9	-75.80	42.04	623.24	612.73	0.86	0.85	-0.02	17
6243030	5792	11.40	47.28	913.62	636.21	0.53	-6.55	-0.30	17
4115080	5796.4	-122.91	46.28	1413.23	1117.80	0.34	-1.23	-0.21	17
4121110	5801.6	-101.62	47.29	27.23	26.75	0.41	0.31	-0.02	17
4214275	5810	-95.77	56.94	223.04	187.11	0.73	0.45	-0.16	17
4122250	5827.5	-93.94	39.93	220.60	288.28	0.83	0.65	0.31	17
4133260	5853.4	-88.74	44.40	262.68	324.59	0.47	-1.35	0.24	17
1160850	5887	30.38	-28.06	82.64	59.37	0.81	0.65	-0.28	17
4126300	5887.1	-95.75	34.03	238.04	237.37	0.78	0.77	0.00	17
4148321	5905	-80.39	35.86	394.18	463.73	0.68	0.17	0.18	17
4213057	5920	-112.51	49.90	18.37	17.02	0.38	-2.88	-0.07	17
4207321	5930	-121.57	52.61	698.70	416.75	0.60	-6.90	-0.40	17
4115240	5931.1	-119.33	45.90	77.26	24.88	0.15	-3.17	-0.68	17
4119311	5941.5	-87.67	41.16	370.90	395.06	0.24	-0.24	0.07	17
3669630	5945	-55.78	-29.78	621.52	700.73	0.89	0.81	0.13	17
4121311	5962.2	-96.92	42.82	51.22	108.00	0.52	-1.11	1.11	17
2421200	5983	47.85	35.67	11.56	38.46	0.46	-25.83	2.59	17
4208916	5990	-111.20	57.65	181.90	90.15	0.41	-3.82	-0.50	17
4133700	5990.7	-85.66	43.44	310.10	221.52	0.44	-3.99	-0.29	17
4135205	6003.6	-84.40	41.24	371.14	408.87	0.80	0.71	0.10	17
4122639	6008.8	-98.74	41.04	29.21	57.02	0.77	-40.05	0.95	17
4119170	6050.2	-90.54	41.77	339.94	381.68	0.82	0.73	0.12	17
4122155	6055.4	-106.51	42.01	22.93	10.28	0.37	-0.44	-0.55	17
4120125	6086.5	-108.43	44.84	115.58	13.02	0.32	-2.62	-0.89	17
4122636	6086.5	-99.39	41.78	81.85	78.50	0.25	-5.57	-0.04	17
4215103	6090	-119.61	49.50	76.82	102.87	0.13	-0.98	0.34	17
6935500	6119	9.64	47.38	1182.27	1022.41	0.63	-0.22	-0.14	17
4213810	6130	-97.36	56.00	186.25	234.41	0.81	0.44	0.26	17
6340600	6171	12.58	51.59	330.79	299.98	0.59	0.41	-0.09	17
6246612	6214	15.28	47.41	564.34	587.54	0.64	0.53	0.04	17
4134300	6216	-84.23	43.60	278.89	228.71	0.29	-0.57	-0.18	17
6337507	6366	9.47	51.23	267.87	289.84	0.77	-0.39	0.08	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4150605	6368.8	-96.94	32.97	128.00	148.17	0.53	0.43	0.16	17
4203410	6370	-136.29	62.06	78.86	51.35	0.42	-0.54	-0.35	17
4119290	6423.2	-91.41	39.61	292.36	380.33	0.80	0.57	0.30	17
4116200	6475	-118.14	46.76	71.03	62.38	0.12	-0.22	-0.12	17
4121340	6475	-95.79	42.47	190.22	171.35	0.55	0.52	-0.10	17
4220500	6490	-110.47	48.99	69.48	23.79	0.73	-6.70	-0.65	17
4147715	6490.5	-76.63	42.01	385.37	421.62	0.87	0.80	0.09	17
4148535	6526.8	-81.09	34.01	261.17	348.99	0.71	0.07	0.34	17
4115223	6526.8	-119.43	44.81	163.15	65.97	0.30	-2.48	-0.60	17
4123095	6622.6	-87.74	35.93	502.08	602.73	0.82	0.31	0.20	17
4118110	6734	-119.10	39.15	11.93	3.64	0.05	-0.25	-0.69	17
6246611	6791.5	15.32	47.16	544.71	476.97	0.80	0.23	-0.12	17
4116350	6811.7	-115.72	42.77	38.80	11.57	0.37	-1.49	-0.70	17
4119070	6837.6	-93.74	45.09	166.31	161.09	0.25	0.16	-0.03	17
4119317	6843.4	-88.79	41.39	317.07	378.86	0.69	0.31	0.19	17
4215102	6860	-119.58	49.34	73.58	102.87	0.13	-1.48	0.40	17
4148610	6863.5	-81.41	32.19	205.08	298.67	0.62	-0.28	0.46	17
4121130	6889.4	-102.16	45.20	20.54	15.71	0.06	0.00	-0.22	17
4126100	6894.6	-94.39	33.92	494.06	497.04	0.82	0.78	0.01	17
1160320	6903	19.54	-32.50	33.72	5.67	0.78	-1.35	-0.81	17
4116401	6941.2	-116.44	43.93	307.20	70.42	0.37	-5.66	-0.77	17
4148121	6972.3	-77.59	35.26	324.48	391.65	0.68	0.17	0.21	17
6336900	6983	6.64	49.41	311.53	358.29	0.80	0.23	0.15	17
2423350	6994	48.89	33.22	138.37	27.61	0.68	-4.03	-0.80	17
1259110	7000	18.22	-26.80	43.65	2.54	0.04	-0.96	-0.84	17
4115282	7006	-121.32	44.50	111.94	87.38	0.01	-6.93	-0.22	17
4147050	7031.9	-69.89	45.05	632.55	625.86	0.79	0.75	-0.01	17
4127201	7042.2	-89.36	38.61	319.19	397.60	0.47	0.04	0.25	17
4148570	7070.7	-80.39	33.03	223.56	245.08	0.61	0.34	0.10	17
4152900	7163.9	-109.29	33.05	19.86	16.18	0.04	-0.24	-0.19	17
4148310	7226.1	-79.25	34.06	288.63	316.52	0.45	0.26	0.10	17
4116460	7252	-116.28	43.66	111.44	31.10	0.08	-1.62	-0.72	17
4122160	7267.5	-95.63	40.63	232.83	246.21	0.74	0.73	0.06	17
4147501	7277.9	-73.60	43.27	707.99	607.93	0.82	0.20	-0.14	17
4207810	7280	-121.23	50.34	104.37	99.43	0.13	0.03	-0.05	17
4127700	7283.1	-90.70	32.35	474.48	604.71	0.83	0.08	0.27	17
4115450	7288.3	-114.06	46.84	265.13	52.19	0.33	-10.26	-0.80	17
4122230	7303.8	-97.87	39.01	12.98	19.23	0.06	-0.87	0.48	17
4121304	7303.8	-98.68	46.89	30.72	53.19	0.08	-0.49	0.73	17
4152200	7327.1	-108.68	32.73	23.08	10.57	0.31	-0.64	-0.54	17
4116335	7329.7	-114.60	45.29	123.67	72.34	0.37	-3.00	-0.42	17
4122280	7355.6	-91.98	37.94	311.06	394.30	0.84	0.51	0.27	17
4125552	7381.5	-104.49	36.30	3.09	9.37	0.05	-11.96	2.12	17
4146115	7389.3	-123.67	41.05	542.23	271.57	0.52	-1.30	-0.50	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4208397	7400	-121.46	58.27	113.12	147.54	0.55	-0.58	0.30	17
3652210	7440	-41.13	-14.61	14.78	49.60	0.20	-11.67	2.44	17
4116470	7562.8	-111.90	43.83	225.73	78.16	0.22	-7.50	-0.65	17
4215101	7590	-119.57	49.12	71.28	107.59	0.21	-1.81	0.51	17
4147726	7705.3	-77.75	41.32	562.57	521.21	0.89	0.83	-0.07	17
4122370	7744.1	-100.88	40.24	4.02	11.06	0.00	-50.66	1.87	17
4146140	7770	-121.88	42.56	95.26	36.31	0.00	-8.59	-0.62	17
4203210	7800	-139.41	64.04	296.00	153.18	0.13	-8.88	-0.48	17
4213041	7860	-114.06	51.05	346.33	152.02	0.62	-9.16	-0.56	17
4150465	7889.1	-98.72	31.21	14.71	66.62	0.73	-67.17	3.53	17
4148546	7899.5	-80.97	34.99	346.22	430.25	0.72	0.24	0.24	17
6335601	7916	9.16	49.07	338.53	427.48	0.73	-1.48	0.26	17
4214470	7950	-87.94	53.71	306.72	218.66	0.48	-0.26	-0.29	17
4147381	8008.3	-71.47	42.95	670.59	581.31	0.95	0.73	-0.13	17
4152570	8029	-109.69	41.54	21.35	11.56	0.34	0.06	-0.46	17
4123111	8034.2	-88.16	38.06	393.99	478.50	0.74	0.22	0.21	17
4121150	8047.1	-100.38	44.32	18.21	10.94	0.06	-0.04	-0.34	17
4146180	8062.7	-124.10	40.49	737.57	454.98	0.82	-0.03	-0.38	17
4147902	8104.1	-78.46	39.54	371.13	427.08	0.90	0.70	0.15	17
6457840	8140	18.74	51.61	169.22	178.96	0.64	-0.92	0.06	17
4151650	8143	-106.11	36.07	49.25	18.54	0.00	-5.36	-0.62	17
4120100	8220.7	-105.17	48.17	11.21	16.28	0.35	-0.23	0.45	17
4122281	8236.2	-91.82	38.39	322.03	394.90	0.53	0.24	0.23	17
3651400	8250	-46.57	-17.50	362.93	401.25	0.52	0.14	0.11	17
4215100	8280	-119.42	48.94	63.46	102.87	0.18	-2.46	0.62	17
4122271	8365.7	-94.68	38.23	206.39	302.35	0.78	0.23	0.46	17
6338100	8369	7.23	52.74	293.60	329.50	0.71	-0.56	0.12	17
4116400	8391.6	-116.92	44.05	258.42	70.42	0.40	-4.71	-0.73	17
4150461	8409.7	-99.11	30.66	25.75	60.92	0.52	-8.39	1.37	17
4147110	8451.2	-70.21	44.07	734.09	668.08	0.84	0.65	-0.09	17
6342925	8467	12.70	48.68	628.36	518.58	0.62	-1.17	-0.17	17
4119251	8471.9	-91.54	41.66	296.67	277.04	0.90	0.82	-0.07	17
4123250	8547	-84.31	38.71	460.12	596.96	0.68	-0.37	0.30	17
4208225	8560	-125.40	61.53	374.19	253.05	0.11	-4.83	-0.32	17
4121430	8572.9	-100.97	46.84	29.39	22.52	0.13	0.05	-0.23	17
4122211	8609.2	-96.86	39.78	52.65	90.21	0.81	-2.48	0.71	17
4119201	8650.6	-89.07	42.61	287.34	380.71	0.72	-0.30	0.32	17
4147720	8686.9	-77.13	40.48	434.81	458.46	0.90	0.88	0.05	17
4152700	8831.9	-108.03	40.51	145.07	43.30	0.35	-2.67	-0.70	17
4115102	8857.8	-123.17	44.27	1069.12	806.32	0.50	-0.81	-0.25	17
4214310	8880	-95.12	54.86	177.11	174.27	0.21	-0.08	-0.02	17
4132200	8883.7	-92.42	46.70	223.44	224.66	0.52	0.46	0.01	17
4126350	8907	-98.30	34.06	22.04	70.70	0.61	-17.97	2.21	17
4119285	8912.2	-93.95	41.54	232.14	207.75	0.77	0.69	-0.11	17

GRDC_NO	AREA	Longitude	Latitude	R_GRDC	R_PwM	R^2	NSE	ralBIAS	n
4115261	9010.6	-120.47	46.54	344.40	166.19	0.16	-4.89	-0.52	17
4147601	9013.2	-74.79	41.31	636.96	639.29	0.87	0.87	0.00	17
4126851	9033.9	-99.29	34.17	9.13	22.85	0.47	-7.07	1.69	17
4213355	9090	-96.61	51.71	244.41	247.37	0.50	0.49	0.01	17
4208947	9100	-115.84	54.01	195.38	176.76	0.21	-0.15	-0.10	17
4121341	9132.3	-95.99	41.97	186.75	200.52	0.47	0.43	0.07	17
6142120	9146	17.31	48.94	189.24	212.35	0.78	0.38	0.12	17
4148545	9168.6	-80.88	34.84	368.16	409.44	0.72	0.54	0.11	17
4115305	9194.5	-119.62	48.99	210.13	193.46	0.46	0.26	-0.08	17
4122221	9207.5	-100.86	38.79	0.26	10.08	0.11	-3217.29	48.72	17
4208335	9270	-119.82	61.16	176.41	108.16	0.61	-0.61	-0.39	17
4208561	9350	-121.62	56.25	220.38	198.30	0.60	0.47	-0.10	17
4123230	9401.7	-84.57	39.39	423.62	471.27	0.64	0.43	0.11	17
4133500	9494.9	-86.26	41.84	352.43	343.50	0.33	-0.31	-0.03	17
4152580	9660.7	-108.42	40.55	46.39	9.12	0.36	-1.65	-0.80	17
6340611	9707	13.41	52.51	84.44	174.23	0.26	-8.20	1.06	17
4215660	9710	-117.19	51.49	529.10	276.94	0.72	-12.77	-0.48	17
4127100	9810.9	-90.59	38.51	309.93	412.38	0.76	0.07	0.33	17
4215180	9840	-118.21	48.99	261.88	141.12	0.39	-3.99	-0.46	17
4115311	9842	-118.21	48.98	261.83	110.05	0.46	-6.46	-0.58	17
4208835	9860	-113.06	58.33	109.21	87.46	0.11	-0.18	-0.20	17
4125025	9888.6	-95.44	37.90	163.12	167.39	0.85	0.84	0.03	17
4115403	9945.6	-116.98	47.70	530.16	251.31	0.32	-3.69	-0.53	17